

# Technology Scan

## Focus: Artificial Intelligence technologies for climate resilience

### INTERNATIONAL

#### Generative AI model for Earth observation

The new foundation model from IBM and the European Space Agency (ESA) combines insights from nine types of Earth observation data to provide an intuitive understanding of our planet. IBM and ESA have released TerraMind, a new earth-observation model that the group has open-sourced on Hugging Face. It was pre-trained on TerraMesh, the largest geospatial data set available, built by researchers as part of the TerraMind project.

TerraMind has a unique symmetric transformer-based encoder-decoder architecture, which is designed to work with pixel-base, token-base, and sequence-base inputs and learn correlations across modalities. Despite being trained across 500 billion tokens, TerraMind is a small, lightweight model, using 10 times less compute than standard models for each modality. This means users can deploy it at scale at a lower cost while reducing the overall energy consumption at inference time.

In an ESA evaluation, TerraMind was compared against 12 popular Earth observation foundation models on PANGAEA, a community-standard benchmark, to measure the model's performance on real-world tasks, like land cover classification, change detection, environmental monitoring, and multi-sensor and multi-temporal analysis. The benchmark showed TerraMind outperformed other models on these tasks by 8% or more.

<https://research.ibm.com/>

### ASIA-PACIFIC

#### CHINA

#### AI to revolutionize smart breeding, crop development

The fusion of artificial intelligence (AI) and agriculture is transforming the fu-

ture of food. Smart breeding, powered by AI, is unlocking the potential to develop high-yield, climate-resilient "super crops" that could redefine global food security in an era of environmental uncertainty.

At the 2025 Seed Congress held from March 20 to 23 in the city of Sanya, south China's Hainan Province, smart breeding took center stage. Over 40 exhibitors showcased cutting-edge technologies and flagship crop varieties, highlighting how AI-driven breeding is transitioning from theory to practice. Digital displays at the event illustrated the latest breakthroughs, from AI-powered genomic analysis to cloud-based farm monitoring systems.

Qian Qian, another CAS academician, highlighted the complexity of crop traits. "Understanding the relationship between genes and traits requires computational power and advanced algorithms," he said. Unlike traditional small-scale breeding, smart breeding adopts an industrialized approach, pooling vast resources to integrate superior traits efficiently.

<https://www.globaltimes.cn/>

#### INDIA

#### AI in hunt for curious corals

Researchers at the National Institute of Ocean Technology (NIOT), Chennai have created an AI algorithm capable of tracking "curious" corals using autonomous underwater vehicles (AUVs). Curious corals are new species of coral reefs found in deep-sea expeditions or coral reefs that appear to be resistant to climate change.

This new technology, developed from images collected by the PROVe500 in the Andaman and Nicobar Islands, promises to significantly enhance our understanding of coral reef ecosystems and the impact of climate change on these vital marine habitats. The AI algorithm, trained on six distinct families of coral images,

uses advanced computer vision and deep learning techniques. It utilises the YOLOv8 model for coral detection and classification, combined with ByteTrack for tracking, achieving impressive mean average precision and recall rates of 97.4% and 96.8%, respectively.

This high accuracy allows AUVs to identify and monitor corals in real-time across large spatial domains, reducing the need for manual intervention by divers and minimizing subjective decisions. By deploying AUVs equipped with AI-enabled image processing, researchers can gather comprehensive data on coral health and dynamics over extensive areas.

<https://www.indiatoday.in/>

#### 'Smart Model' to predict flooding in deltaic regions

Researchers from the University of Notre Dame, USA, Indian Institute of Technology (IIT) Kharagpur, India Meteorological Department (IMD), and the National Institute of Hydrology (India) have developed an innovative computer model for predicting floods in deltaic regions.

Their study centres around the Brahmani-Baitarani River delta in Odisha, India, where the two rivers meet to form a delta before pouring out into the Bay of Bengal. The region is notoriously susceptible to floods and cyclones. The team developed an integrated method, where, instead of relying on separate models that only look at the river or the ocean separately, they've linked them together. This allows the models to talk to each other and understand how a storm surge in the Bay of Bengal pushes water up the rivers while heavy rainfall inland swells the rivers at the same time.

The team used three computer models: ADCIRC, SWAN, and HEC-RAS 2D. ADCIRC (Advanced Circulation Model) takes on the task of simulating how water moves in the ocean, accounting for tides and storm surges. SWAN (Simulating Waves Nearshore) focus-

es on the waves and calculates their height and direction. These two work together, with ADCIRC sending information on water levels to SWAN and SWAN returning data on wave forces. Finally, HEC-RAS 2D (Hydrologic Engineering Center's River Analysis System) simulates river flooding, taking into account rainfall and the flow of water downstream. The key to the new model is in the way these three models are connected. The ocean surge data from ADCIRC+SWAN becomes the coastal boundary condition for the HEC-RAS model, informing it how much the ocean is pushing into the rivers.

<https://researchmatters.in/>

### AI model to offer heat-stress predictions

An AI-powered model that provides taluk level heat-stress predictions in Karnataka is being developed by Bengaluru's IISc, which could be a game-changer in predicting high-temperature events that pose major health risks. Researchers from the Indian Institute of Science's (IISc) AI & Robotics Technology Park (ARTPARK) are the brains behind the model that provides heat predictions for up to 10 days. AI-based models generate weather forecasts faster and with significantly lower computational resources, unlike current forecasting systems that require large supercomputers. ARTPARK researchers, who are testing the model, in the next couple of weeks, will hand it over to the Karnataka State Natural Disaster Monitoring Centre (KSNDMC), one of the key stakeholders along with the IMD and state health and family welfare department. As of now, researchers are sharing heat maps with the KSNDMC. In the IISc model, people can understand maximum temperature distribution, anomalies, and daily temperature variations. They can also calculate thermal comfort and a heat risk index, apart from getting a 10-day forecast, which will show how the temperature feels (human perception) by combining humidity levels, geographical conditions, and wind speeds.

<https://www.deccanherald.com/>

## ISRAEL

### AI model to predict lightning-induced wildfires

A new artificial intelligence (AI) model developed by researchers at Bar-Ilan University (BIU) in Ramat Gan promises to revolutionize wildfire prediction, with a particular focus on lightning-induced blazes that are growing increasingly common due to climate change. The new AI model can predict where and when lightning strikes are most likely to cause wildfires, achieving over 90% accuracy – a first in wildfire forecasting that could transform emergency response and disaster management worldwide.

Dr. Oren Glickman and Dr. Assaf Shmuel from the computer science department, in collaboration with experts from Ariel University and Tel Aviv University (TAU), worked with seven years of high-resolution global satellite data, alongside detailed environmental factors like vegetation, weather patterns, and topography, to map and predict lightning-induced wildfire risks on a global scale. Their research was recently published in Nature Publishing's *Scientific Reports* under the title "Global lightning-ignited wildfires prediction and climate change projections based on explainable machine learning models."

What makes this so significant is the ability to predict lightning-induced wildfires with remarkable precision. The AI model outperforms traditional fire danger indices by taking a global, data-driven approach. It integrates environmental factors, data from satellites, and weather systems to assess the likelihood of lightning-induced fires, overcoming the limitations of regional and data-restricted models.

<https://www.jpost.com/>

## PHILIPPINES

### AI-powered platform for hybrid rice breeding

The International Rice Research Institute (IRRI) has launched a new AI-powered digital platform that can signifi-

cantly advance and accelerate hybrid rice breeding and parental selection around the world, contributing to improved food security and sustainable agriculture through the propagation of high-yielding and climate-smart rice hybrids.

Called the Global AI-Hybrid Rice Platform (GAI-HRP), the platform was developed by the IRRI Hybrid Rice Unit with the Hybrid Rice Development Consortium (HRDC). The system utilizes advanced artificial intelligence and machine learning models to interrogate datasets across decades of research and trials and to provide swift and precise identification of optimal hybrid rice combinations based on specific parameters.

With the GAI-HRP system, the AI will be able to quickly and accurately predict the highest-yielding F1 rice hybrid combinations using SNP genotypic data of the male and female parental lines, while also considering the various market segments and available historical hybrid datasets. This can significantly help breeders, researchers, and seed companies to determine the best combinations for hybrid rice development by specific traits, environments, and markets.

In addition to optimizing yield potential, GAI-HRP also indirectly contributes to sustainable agriculture by identifying low-carbon footprint rice hybrids. This is achieved by considering high-yielding and early-maturing hybrid rice varieties, which require fewer resources and reduce greenhouse gas emissions. Furthermore, the platform is being developed and enhanced to predict the most significant gene panels for targeted hybrid rice traits, helping to improve breeding efficiency and precision.

<https://www.irri.org/>

## EUROPE

### AI tool to help detect growing climate hazards

A JRC-developed expert-driven explainable AI (xAI) model can detect multiple climate hazards impacting agriculture in Europe. It enables probabilistic detection and uncertainty estimation of

areas of concern, hence improving risk management. By integrating decades of expert knowledge with advanced explainable AI (xAI) techniques, a team of researchers led by the European Commission's Joint Research Centre (JRC) has developed an expert-driven model that can detect multiple climate hazards affecting agriculture in Europe.

The model - described in a scientific article published in *Nature* - can improve risk management and adaptation, helping to boost the resilience of agriculture in Europe. This marks a step towards developing more robust and reliable multi-hazard early warning systems for agriculture. By combining the power of AI with the irreplaceable expertise of domain specialists, this model can help to improve climate resilience and safeguard food security in the face of increasing climate variability in Europe.

The model builds on the expertise of agro-climatic specialists who have operationally identified areas of concern (AOCs) where specific climate hazards may impact agriculture, such as droughts, heatwaves, and extreme precipitation events. By learning from this rich dataset, the model can efficiently digest big agro-meteorological datasets in a timely fashion to provide first guesses of AOCs relevant for agriculture in Europe.

Unlike traditional black-box AI models, this system provides clear explanations for its predictions by showing the key factors driving the detection of AOCs. For instance, the model reveals the critical role of specific atmospheric circulation patterns in driving drought conditions, allowing for more accurate drought impact-based forecasting and preparedness. The transparency and interpretability embedded in the model helps to build trust and allows stakeholders to understand potential underlying causes of risk.

<https://joint-research-centre.ec.europa.eu/>

### AI-powered robots tackle e-waste problem

EU-funded researchers have developed adaptable robots that could transform the way we recycle electronic waste, benefiting both the environment and

the economy. Researchers from Slovenia, Germany, and Italy worked together on this issue at the Jožef Stefan Institute, Slovenia's leading research facility, from 2020 to 2024. The team developed adaptable AI-supported robots that are able to remove batteries from smoke detectors and radiator heat metres. These two products can be found in most households and are replaced every five to eight years, creating large amounts of waste.

Working with ElectroCycling, Ude's international research team created an adaptable robotic work cell. This is a workspace that consists of at least one robot, its tools and equipment, and its controller.

The novelty here is that this closed system autonomously adapts itself to various tasks, with the help of complex AI-driven software and modular hardware that can be quickly reconfigured. It also uses soft components like SoftHand, a human-like hand that can manipulate objects with great precision. There are also safety features like collaborative robots and emergency stop buttons.

<https://projects.research-and-innovation.ec.europa.eu/>

## UK

### AI driven weather prediction system

A new AI weather prediction system, developed by researchers from the University of Cambridge, can deliver accurate forecasts tens of times faster and use thousands of times less computing power than current AI and physics-based forecasting systems. The system, Aardvark Weather, has been supported by the Alan Turing Institute, Microsoft Research, and the European Centre for Medium-Range Weather Forecasts. It provides a blueprint for a new approach to weather forecasting with the potential to transform current practices. The results are reported in the journal *Nature*.

The researchers have replaced the entire weather prediction pipeline with a single, simple machine-learning model. The new model takes in observations

from satellites, weather stations, and other sensors and outputs both global and local forecasts. This fully AI-driven approach means predictions that were once produced using many models – each requiring a supercomputer and a large support team to run – can now be produced in minutes on a desktop computer.

<https://www.cam.ac.uk/>

### AI tools help reduce greenhouse gas emissions

Loughborough University computer scientists have developed AI tools that offer insights into how greenhouse gas emissions associated with UK livestock farming and land use can be reduced. The tools – which are hosted on an online digital platform and created as part of research funded by UK Research and Innovation (UKRI) and the Engineering and Physical Sciences Research Council (EPSRC) – aim to provide farmers, farming organizations, and government bodies with valuable data on how changes in livestock practices and land use can help the UK achieve its 2050 net zero goal.

Developed by a team led by Professor Baihua Li and Professor Qinggang Meng, key features of the platform include machine learning models designed to estimate methane emissions from livestock farming, predict milk productivity and ammonia emissions from dairy farms, and analyze how land use and environmental factors influence methane emissions across the UK.

The Loughborough University AI models provide a solution. Trained on diverse livestock and environmental datasets, they analyze how various factors interact to impact emissions, providing farm-level and nation-wide insights that can help shape strategies to support the UK's net zero goal.

The AI tools developed for livestock farms allow farmers to input details about their specific animals and practices to estimate their current annual greenhouse gas emissions. Farmers can easily explore potential changes to their practices – simply by selecting options from drop-down menus or entering variable values. These adjustments provide immediate insights into

their potential impact on both emissions and farm productivity.

<https://www.lboro.ac.uk/>

## NORTH AMERICA

### USA

#### AI technique boosts climate change defenses

Researchers from Princeton and Rutgers University have used reinforcement learning, a method frequently deployed to train artificial intelligence, to show how flexible responses can substantially increase the cost-effectiveness of steps to defend cities like New York against climate change.

The research is part of an attempt to grapple with the effort to make expensive, long-term investments to mitigate the impacts of climate change. The substantial uncertainty related to long-term climate change makes it difficult for political leaders to make investments now that are designed to protect citizens for decades or longer. The difficulty is enhanced by the vast number of variables that go into any such decision and by the fact that the variables are likely to shift in unforeseen ways.

In a March 18 article in the *Proceedings of the National Academy of Sciences*, the researchers looked at flooding, which has caused increasing damage along the coastal United States and around the world. Governments are building coastal defenses against flooding, but they cannot rely on past conditions to guide defenses that will be needed in the future.

In the PNAS article, the team describes how they simulated efforts to defend Manhattan against sea level rise through the end of this century. The goal was to determine whether any decision-making process that systematically incorporates observations and updating would prove superior to oth-

ers over such a long period of time. To do this, the researchers simulated decisions by city planners in 10-year intervals up to the year 2100. The researchers compared their decision-making process with existing methods.

<https://engineering.princeton.edu/>

#### Climate modeling with generative AI

Researchers at the University of California, San Diego, and the Allen Institute for Artificial Intelligence (AI2) have developed a generative AI climate prediction model they call Spherical Diffusion, which is fast and agile enough to be used as a tool not just by scientists, but by anyone whose decisions are affected by climate trends.

In their recently published paper online, the researchers explained the difference between climate modeling and weather forecasting. "Climate models are foundational tools used to understand how the Earth system evolves over long time periods and how it may change as a response to possible greenhouse gas emission scenarios ... There are fundamental differences between weather and climate modeling. Climate refers to the average weather over long periods of time. While weather forecasting focuses on short time scales in the order of days or weeks, climate modeling simulates longer periods of decades to centuries."

"What people have usually been using for climate modeling are physics-based climate models, which solve equations about the atmosphere and oceans and so on," said Salva Ruhling Cachay, one of the Ph.D. students of UCSD Professor Rose Yu. "These models are run on supercomputers to make predictions for 10s or even 100 years. But running such a physics-based model is very expensive in terms of time and compute and energy," he added. Where it takes about six months to run a physics-based model, theirs was able to

produce equally good results in about two weeks.

<https://www.techbriefs.com/>

#### AI model for tornado damage assessments and recovery

Led by Dr. Maria Koliou, associate professor and Zachry Career Development Professor II in the Zachry Department of Civil and Environmental Engineering at Texas A&M University, researchers have developed a new method that combines remote sensing, deep learning, and restoration models to speed up building damage assessments and predict recovery times after a tornado. Once post-event images are available, the model can produce damage assessments and recovery forecasts in less than an hour. The researchers published their model in the journal *Sustainable Cities and Society*.

The model does more than assess damage—it also helps predict repair costs and estimate recovery times. Researchers can assess these timelines and costs in different situations by combining deep learning technology, a type of artificial intelligence, with advanced recovery models.

Researchers combined three tools to create the model: remote sensing, deep learning, and restoration modeling. Remote sensing uses high-resolution satellite or aerial images from sources such as NOAA to show the extent of damage across large areas.

Deep learning automatically analyzes these images to identify the severity of the damage accurately. The AI is trained before disasters by analyzing thousands of images of past events, learning to recognize visible signs of damage such as collapsed roofs, missing walls, and scattered debris. The model then classifies each building into categories such as no damage, moderate damage, major damage, or destroyed.

<https://phys.org/>